



## Original Article

## Evaluation of Palatal Rugae in Patients for Maxillary Dental Prostheses

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## ABSTRACT

Significance and importance of palatal soft tissue rugae increases many folds when replacement of missing maxillary teeth with conventional complete denture is part of treatment plane. **Objectives:** To quantify the shape and size of rugae in completely and partial edentulous arches in both males and females. **Methods:** A total of 200 patients were selected on the basis of inclusion and exclusion criteria and after obtaining informed consent, impression with Alginate impression material were made and poured to form dental casts. Pattern and shapes of rugae were delineated with graphite marker. Under a good source of light different shapes, thus outlined, were counted in number and measured in length, categorizing them in various shapes such as divergent, wavy, curved and straight. Age, arches were computed for frequency and measuring the mean with standard deviation. All data were computed by using SPSS (version 22). **Results:** Out of 200 patients, a male (n=89) to female (n=111) ratio of 0.80 was found with a mean age of 52.6 and standard deviation of 11.3. Partially edentulous cases were 51%, while the rest were completely edentulous. A total of 1367 rugae were found in both types of patients. Females had more number of rugae (n=773) than males (n=594). Similarly primary rugae were higher in numbers (n=1132) than secondary rugae (n=235) and the observed difference was statistically significant (p=0.001). **Conclusions:** It was concluded in this study that female and partially edentulous arches had more numbers of rugae as compared to males and completely edentulous arches respectively.

## INTRODUCTION

Conventional complete denture depends on soft and hard tissue for support. Rugae in anterior part of the maxillary hard palate have been of great significance for support purposes of prosthesis, resisting or limiting denture displacement anteriorly and identifying person's identification. Establishing a person's identity is necessary for personal, legal, criminal and social reasons. Identification of individuals in postmortem cases, from orofacial structures has been considered as economical alternatives to DNA profiling, fingerprints and other time consuming and expensive procedures. Amongst these maxillary palatal rugae has been used since very long in cases of mutilated individuals who are edentulous and sustaining disfigurement injuries. This advantage is mainly due to its concealed location and protection provided by

tongue, teeth, lips and other soft and hard tissues [1]. Apart from this, rugae have been considered important for the support purposes of removable complete dentures in completely edentulous patients. This kind of secondary support supplements the support provided by hard palate and maxillary tuberosity on either side of the arch. Rugae also provide a guide to the placement of anterior margin and border allocation of major connectors for cast removable partial dentures. Rugoscopy, the study of palatal rugae pattern, reveals many important aspects of rugae. Rugae, present along each side of the mid-palatine raphae and behind the incisive papilla, are transverse irregular folds of connective tissue with thickened epithelium, which vary in symmetry, size, shape and number hence they are valuable landmarks for assessment

of orthodontic tooth movement and for the identification of sub-mucosal clefts. They also are substantial for prosthesis support, taste perception and accommodating patients having speech problems to their new prosthesis. A study carried out by Sharif et al., on certain group of people regarding rugae shape, direction and unification revealed curved shaped rugae as the most frequent pattern [2]. Similarly, a study carried out in Turkish subpopulation wavy type was the most common (44.2%) rugae shape and most common alignment was horizontal [3]. Assessing predominant rugae pattern and their variation amongst five different linguistic populations, a local study showed wavy as a predominant pattern, followed by straight, while curved was most common amongst Punjabi and Pushto speaking groups, wavy followed by curved and straight was common among Sindhi and Urdu speaking groups [4]. There is general consensus on the stability of rugae pattern throughout life of an individual, never the less, under certain circumstances changes may be anticipated for example underneath partial/ complete dentures and during orthodontics treatments [5, 6]. Different authors from different regions have observed variations of palatal rugae in different ethnic population. The present study aimed to analyze the pattern and distribution of the rugae, and to analyze and compare the predominant rugae pattern among males and females. This study further aimed at comparison of rugae pattern in terms of number, size, shape and symmetry in partially edentulous and completely edentulous subjects of either gender. The study will be valuable in terms of understanding the nature of rugae serving for the support and indirect retention for different types of teeth replacement prostheses.

## METHODS

This cross sectional study was conducted in outpatient department of prosthodontics, Peshawar Dental College and Hospital, Peshawar. The study was carried out from January to June, 2022; after obtaining the ethical approval certificate from Institutional Review Board. A total of 200 patients including males and females, with an age ranging from 25 years to 75 years and fulfilling the exclusion and inclusion criteria, were selected. The sample size was based on 85% prevalence of straight rugae pattern, having a 95% confidence interval and a 5% margin of error. All participants were selected through convenient sampling technique and an informed verbal consent was sought before recruiting them into the study. The type and nature of the study was explained to them in a simple local language. Inclusion criteria included partially edentulous and completely edentulous patients seeking treatment for their missing teeth. Partially edentulous patients were those who had one or more than one tooth, but not all teeth, missing. Edentulous patients were having no teeth in either

arch and irrespective of wearing or using any complete dentures. Subjects with cleft left and palate and having a history of facial trauma/ surgery were excluded. In both cases an impression of oral cavity was obtained with an Alginate impression material (Happy Buy, China) in a stock tray by the author MSK. After taking disinfection protocol for the impression, these impressions were poured with dental hard plaster type-II (Kopo Hard, CKH-52, China). Care was exercised at each step to avoid damage to the cast. Details of patient related information were recorded on each cast. Casts were examined under a good source of light. Rugae were outlined using graphite pencil and recorded. Rugae were counted on both right and left side of arch on cast. Shape of rugae was classified into four major types. Straight rugae were those running directly from their origin to insertion. Circular rugae which have definite continuous ring, Curved Rugae, which have simple crescent shape which curve gently. Wavy rugae were serpentine in nature. Frequency of each shape of rugae was counted and then tabulated for both right & left side of partially edentulous & completely edentulous casts. Unification occurs when two rugae were joined at their origin or insertion. Convergent rugae began as two separate rugae from their origin and joined at lateral portion. Divergent rugae began as single rugae at origin and diverge laterally. After identification number of converging and diverging rugae was then counted for both right and left sides of the arch. Length of each rugae was measured from origin to insertion using divider and millimeter ruler. For wavy rugae, total length was first divided into segments at highest point of crest and lowest point of trough. Measurements for individual segment was recorded and added to get the total length. For curved rugae three points were marked at origin, deepest point of curve and at termination. Length between these points was measured and then added to get the total length. After determining the length of all the rugae two categories were formed namely primary rugae having a length of more than 5mm and secondary rugae with a length of 3-5mm. Descriptive statistics were calculated for all valuable measurements. Chi-Sq test was used for comparison between partially edentulous and completely edentulous groups. Percentages of all the remaining qualitative records were tabulated. Data were analyzed using statistical package for social sciences (SPSS) version 22.

## RESULTS

This study assessed the rugae in partially edentulous and completely edentulous patients of either gender on dental casts. The rugae were examined in terms of shape, size, location and length. Age of participants ranged from 25 to 75 years with a mean of 52.6 years and a standard deviation of 11.3 years. A total of 200 dental casts were

examined by a single author and the data was calculated and tabulated. Out of a total of 200 casts, 89 (45%) were male, while 111 (55%) were female (ratio of 0.80). Cast of male participants were having partially edentulous (25%) and completely edentulous casts (24%), while out of female participants 26% were partially edentulous and 51(25%) completely edentulous (Table 1).

Gender	Male		Female	
		89(45%)		111(55%)
Edentulous casts	Partially	49(25%)	53(26%)	
	Completely	47(24%)	51(25%)	
Age (yr)	Maximum72	Minimum28	Mean ± SD (52.6 ± 11.33)	

**Table 1:** Gender, Type of casts and Age of patients (SD= Standard Deviation)

Numbers of rugae in male and female participants are shown in Table 2. It also show distribution on right and left side, right side (n=726) being more in number than left side (n=641). Similarly primary rugae (n=1132) are more when compared to secondary rugae (n=235). The results are statistically insignificant.

Gender	Number of Rugae				Length of Rugae					
					Primary >5mm			Secondary (3-5mm)		
					Right	Left	Total	Right	Left	Total
Male	357	237	594	.516	311	195	506	46	42	88
Female	369	404	773	.513	313	313	626	84	63	147
Total	726	641	1367		624	508	1132	130	105	235

**Table 2:** Number and Length of rugae in male and female patients

Distribution of rugae in partially and completely edentulous arches is given in table 3. It is shown in the table that partially edentulous patients were having slightly more number of rugae (56%) when compared to completely edentulous rugae (44%).

Patients	Right n (%)	Left n (%)	Total n (%)
Partially edentulous	403 (29%)	374 (27%)	777 (56%)
Completely Edentulous	335 (25%)	255 (19%)	590 (44%)
Total	738 (54%)	629 (46%)	1367 (100%)

**Table 3:** Number of Rugae in partially edentulous and completely edentulous patients

Frequency of different shapes of rugae in both males and females is given in table 4. Numbers of different shapes of rugae such as wavy, curved and straight were analyzed in both male and female casts on both right and left side. The distribution is quite variable; however, female patients were having more rugae when compared to male.

Dental Casts	Diverging		Wavy		Curved		Straight	
	Right	Left	Right	Left	Right	Left	Right	Left
Male	55	67	82	79	84	82	75	70
Female	49	73	130	119	112	125	90	75
Total	244		410		403		310	

**Table 4:** Frequency of different shape of rugae in dental casts of male and female participants

## DISCUSSION

In a completely edentulous state importance of rugae is increased for support purposes of complete denture. This

is because complete denture is totally dependent on soft and hard tissue for its retention, support and stability like important attributes for its success. Apart from this rugae also contribute to taste perception, identification of texture of food. It can be used as indirect retention in free end saddle situations especially Kennedy Class II partially edentulous cases. Palatal rugae, being unique to an individual, are considered as the important source of forensic identification [7]. Various methods have been documented in different studies for analysis of palatal rugae patterns such as intraoral inspection, digital photography, stereoscopy and stereo-photogrammetry. Though, intraoral study of the palatal rugae is the most common method used universally, however, study of the dental casts obtained through impressions can be more accurate and have an advantage of preservation of the record for longer period of time [8]. In the present study, dental casts were used for their cost effectiveness along with their easy handling, readily availability and can be stored for future use. Moreover study of dental casts need less training on behalf of the examiner while recording different details of the various parameters of palatal rugae. However, the chances of abrasion and damage to the cast must be kept to minimum level in order not to lose fine details of the rugae [9]. A significant numbers of research papers have observed variation in size, numbers and shapes of palatal rugae. These aspects and characteristics of rugae have great variations in terms of ethnic, racial and sometimes intraoral considerations. Very few studies have observed and studied the number of rugae in partially edentulous and completely edentulous individuals. The role of rugae for complete denture support is well documented in literature and cannot be overlooked. The most relevant importance is in terms of vertical support for complete dentures, hence it can be assumed that more are the number and size of these rugae, denture support will be more enhanced in such cases and vice versa. Our study observed, compared and found that a difference was observed in rugae number among partially edentulous and completely edentulous casts with reduction observed in completely edentulous casts. Our finding is in agreement with the conclusions drawn by other studies done earlier by Jawad and Bhatt, where they have a similar finding [9-11]. Similarly changes in the pattern of rugae have been observed by researchers in partially edentulous and completely edentulous individuals. For instance complexity of rugae pattern tends to decrease in completely edentulous cases when compared with partially edentulous cases [12]. Distribution of rugae has been found to be different on right and left side of the same arch. This has been observed in many previous studies [13-15]. Our finding is similar to these studies. It was found in

our study that more number of rugae was present on right side of the arch as compared to the left side. This finding is consistent for both in gender (male/female) and status of edentulism (partially/ completely). The distribution of rugae across the midline of the palate though has been insignificant, never the less, the difference is noticeable. The number, length and shapes of rugae vary in different patients and gender type. Depending on the length, primary and secondary rugae has been found to be variable among partially edentulous and completely edentulous subjects, as observed in various studies carried out earlier. In a large number of studies number of rugae are found to be more in dentate as compared to edentate subjects, however, our study found more rugae in partially edentulous arches as compared to completely edentulous patients [11-13]. Rugae have a vast variety of shapes. Straight, wavy, curved, circular, divergent, convergent, perpendiculars, forward and backward are a few to mention. Again the shape may vary in males, females, partially edentulous and completely edentulous individuals. Our study observed more differences in distribution of wavy and straight rugae in partially edentulous and completely edentulous casts. Analysis of rugae shapes revealed that wavy type of rugae were more commonly (n=410) found in this study, this finding being in line with a study done by Abeer et al., while another study of such a kind found curved to be more in frequency when compared to our study [14, 15]. The difference might be due to the sample size and ethnic differences. In this study the total number of rugae was slightly higher in female, however, the nature of completely edentulous status is different than partially edentulous cases. This finding is similar to the observations of other studies [16-18]. However, our finding is not in line with the result of the study conducted by Saraf et al., which may be due to variation in sample size [19]. Results of another study also found that female has more numbers of rugae than males and this match our result in this regard [20].

## CONCLUSIONS

Within the limitation of the present study it was concluded that no significant difference was found in relation to number and shapes of rugae on both right and left side in males and females, however, females had more rugae than males. Primary rugae were more in numbers as compared to secondary rugae, similarly completely edentulous patients had a slight less number of rugae when compared to partially edentulous arches. Our study did not focus on the ethnicity of the patients, this being limitation of our study can be explored in another study of this kind.

## Conflicts of Interest

The authors declare no conflict of interest.

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